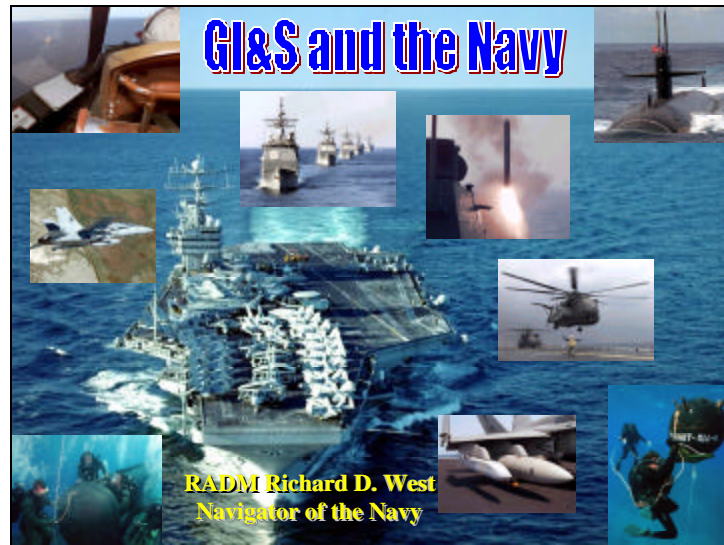




Slide 1



This briefing will serve as the GIS Road Show Briefing. The purpose is to spread the word on what GI&S is and how it serves the warfighter

## Slide 2



### Agenda

- ✓ What is GI&S and Why Digital GI&S
- ✓ Why Is This Important to Me
- ✓ 4-D Cube Battlespace
- ✓ How Digital GI&S Supports the Warfighter
- ✓ Datums and Their Importance
- ✓ Foundation Data Concept
- ✓ How Navigator of the Navy Supports You

### Slide 3



Legacy - Analog paper charts, manual plotting - less efficient employment of data

Today - Still in a mostly paper environment, but moving slowly towards digital

Beyond - Totally digital environment. Near future will include both smart and dumb digital information, but all will be digital and thus more efficient.

Integrated digital environment to create interoperability

More efficient data transfer/update

Increased flexibility and utility of information - supports COP/SIAP

## Slide 4

**What is GI&S?**

- ✓ **Geospatial Information and Services: Geospatial Information** is referenced to a specific location on the earth
- ✓ **Examples include:**
  - Maps & charts
  - Digital Elevation Maps
  - Imagery
  - Geophysical Data (gravity, magnetics)
  - Nautical & Aero Safety Information

Images shown: Topographic map, Surface Chart, Terrain Data, 5M and 1M satellite imagery.

GI&S refers to the information and services that are associated with it: maps, charts guides, Notice to Mariners and Pilots, help desks, web-based availability of products, DLA, etc.

GIS now has two different meanings:

**Geospatial Information Systems**: these include the hardware and software that manipulate the Geospatial Information: systems (FUND, ECDIS-N, Workstations, etc.) and exploitation tools(JMTK, Falcon View, ArcInfo, etc.)

**Geographic Information Systems**: refers to the Navy-wide system proposing to be the database for environmental data (marine mammal data, METOC information, NOAA data, etc.)

Sample GI products:

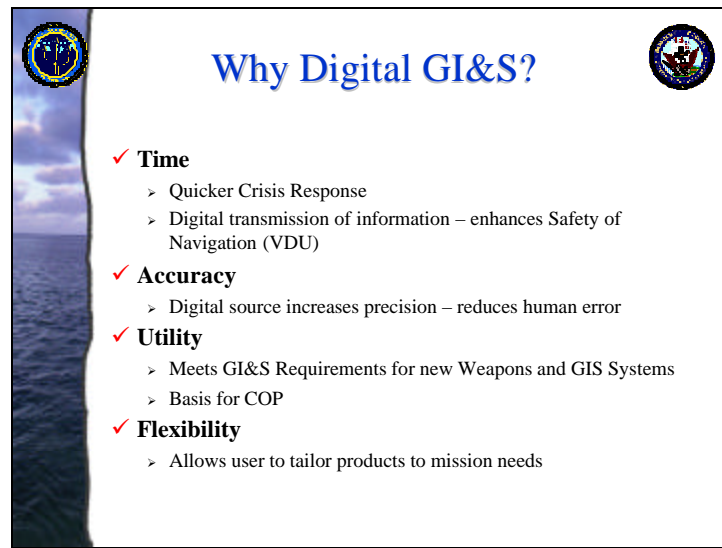
**Jet Navigation Chart** - Aeronautical product 1:2,000,000 scale

**Digital Nautical Chart** - scale varies according to chart type: Harbor/Approach, Port, etc.

**Digital Terrain Elevation Data Level 2** - 30 meter posting, shows 3-d relief

**Controlled Image Base** - both 5-meter and 1-meter; a satellite image that has been georeferenced to the earth

**CD-ROMs** - to illustrate that the notices and products are available in digital format



The slide is titled "Why Digital GI&S?" in blue text. It features a vertical image on the left showing a sunset over the ocean. There are two circular logos, one on the top left and one on the top right. The main content is a bulleted list of benefits, each preceded by a red checkmark.

- ✓ **Time**
  - Quicker Crisis Response
  - Digital transmission of information – enhances Safety of Navigation (VDU)
- ✓ **Accuracy**
  - Digital source increases precision – reduces human error
- ✓ **Utility**
  - Meets GI&S Requirements for new Weapons and GIS Systems
  - Basis for COP
- ✓ **Flexibility**
  - Allows user to tailor products to mission needs

### **Time**

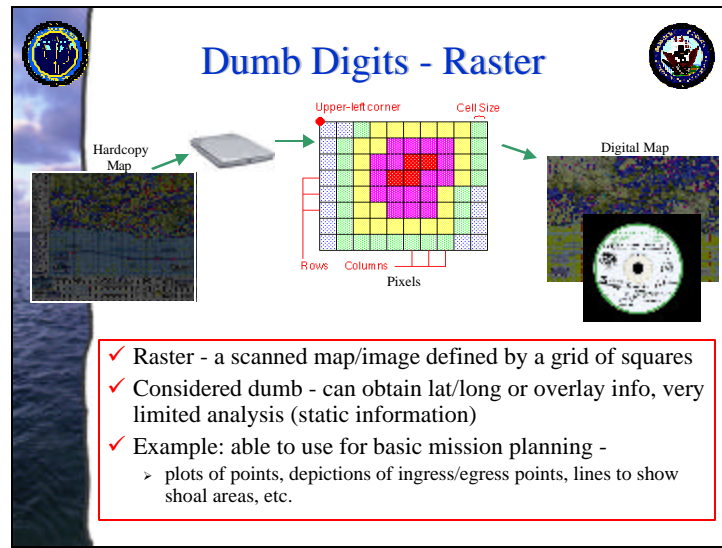
Quicker Crisis Response - automated transmission of data in a crisis will facilitate getting information to the fleet. This will be the exception rather than the rule as the intent is to deploy with what you need in CD-ROM format.

VDU - updates associated with Notice to Mariners will be the critical part of electronic navigation; VDU will allow for a near-realtime update of the digital charts used for navigation.

**Accuracy** – smart digital products provide ability to capture full positional data; hardcopy products are limited by scale and symbology

**Utility** – digital GI forms the basis for the Common Operational Picture and Common Relevant Operational Picture; offers flexibility to tailor information to display only what you need for the mission

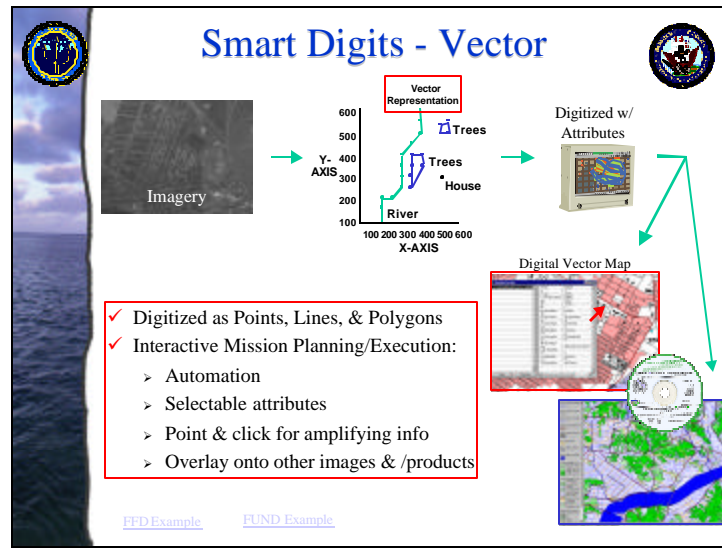
## Slide 6



Raster is just a photo of a map or image captured in a digital environment. It is only as good as the scale of the item scanned.

A static form of digits – not nearly as powerful as vector

## Slide 7




Shows that an image is digitized by identifying areas by points, lines or polygons vice scanning the image.

Hyperlinks are as follows:


FFD is a Foundation Feature Data example to show Point & Click attributes available for mission planning

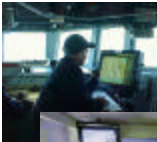
FUND Example is one that shows how you can “automate” a DNC to show buoys and shoal water approaching.


## Slide 8




### Why is This Important To Me?





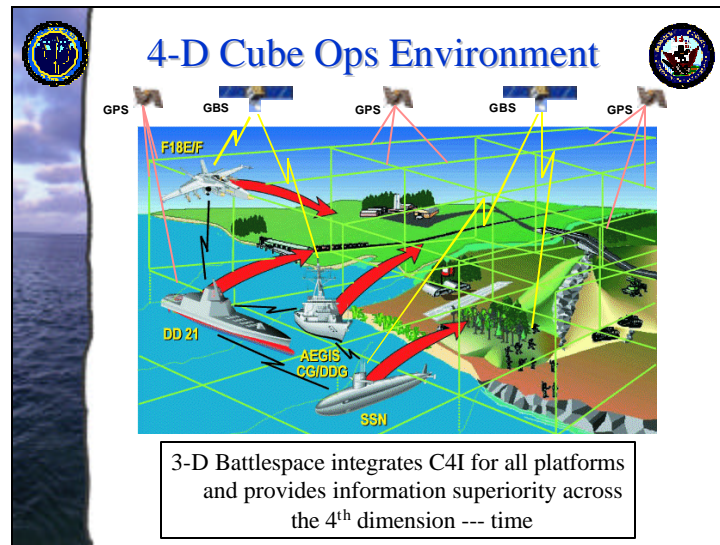




- ✓ Allows use of Electronic Navigation which enhances Safety of Navigation
- ✓ Enhances interoperability
- ✓ Digital Data touches every part of your mission
- ✓ Foundation of how we will fight wars – 4-D Cube

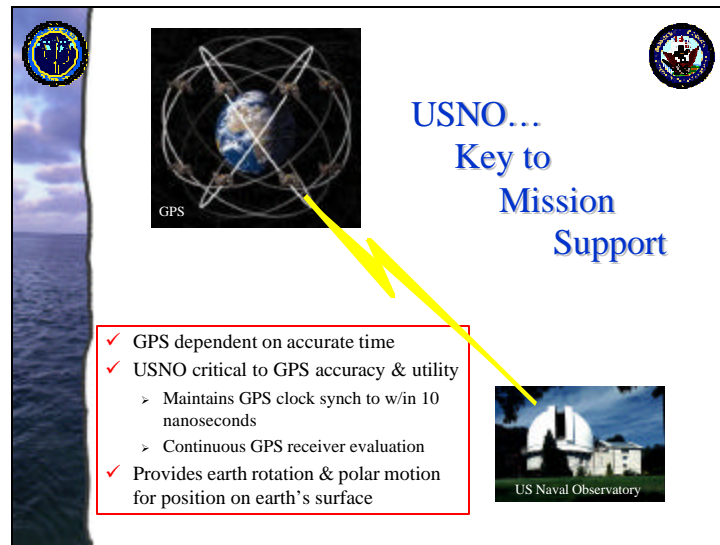


## Slide 9



This is still a work in progress - looking for a better representation! Supposed to depict the 3-D Battlespace with the addition of the fourth dimension of time. This shows the interoperability of platforms and shore-based units, receipt of information and communications between units, and GBS satellite connectivity for exchanging information. Continuity and update over time adds the fourth dimension.

## Slide 10



**USNO...  
Key to  
Mission  
Support**

- ✓ GPS dependent on accurate time
- ✓ USNO critical to GPS accuracy & utility
  - Maintains GPS clock synch to w/in 10 nanoseconds
  - Continuous GPS receiver evaluation
- ✓ Provides earth rotation & polar motion for position on earth's surface

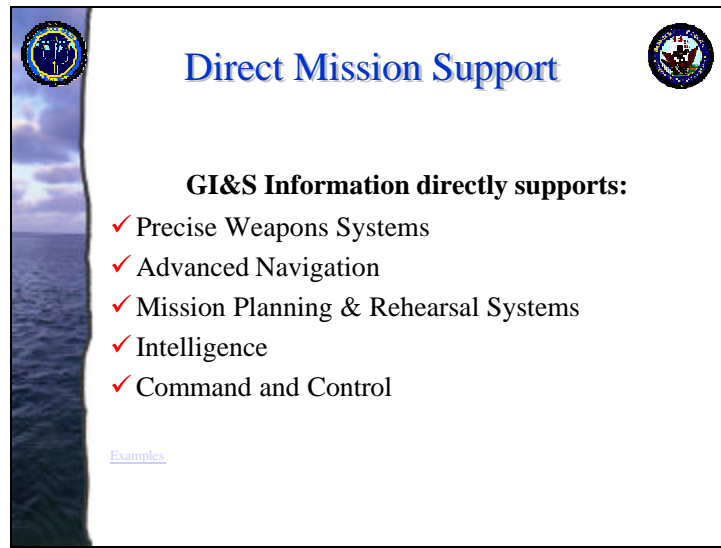
US Naval Observatory

GPS verifies orientation to the earth by using nearby stars and bases that position on the precise measurements provided by USNO. GPS accurate location relative to the earth plus accurate time synchronization is critical to GPS users for accurate positioning.

USNO continuously monitors GPS receiver stations and evaluates time synchronization to within 10 nanoseconds. The GPS is limited to no better than 10 nanoseconds; however, if improved, USNO could provide a synchronization to within 1 nanosecond.

Accurate measurements of earth rotation and polar motion are essential to being able to effectively locate your position on the surface of the earth.

## Slide 11



The slide features a vertical image on the left side showing a sunset over the ocean. The title "Direct Mission Support" is centered at the top in blue. Below it, the text "GI&S Information directly supports:" is followed by a bulleted list of five items, each preceded by a red checkmark. At the bottom left, there is a small blue hyperlink labeled "Examples". Two circular emblems are positioned in the top corners of the slide content area.

### Direct Mission Support

**GI&S Information directly supports:**

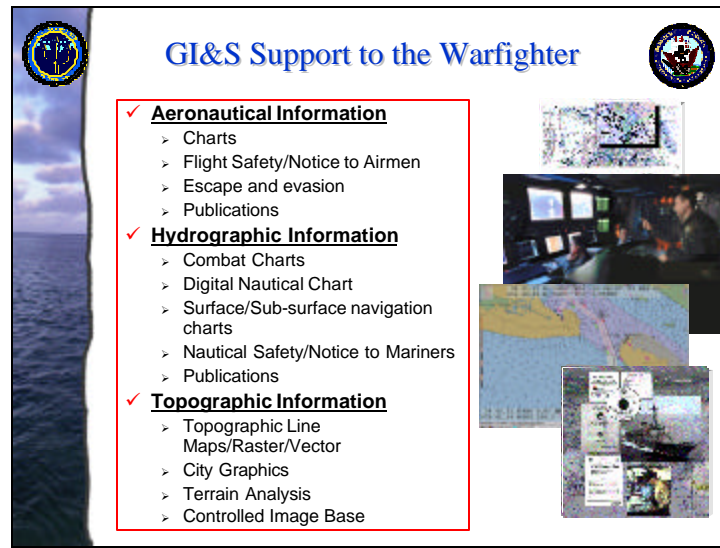
- ✓ Precise Weapons Systems
- ✓ Advanced Navigation
- ✓ Mission Planning & Rehearsal Systems
- ✓ Intelligence
- ✓ Command and Control

[Examples](#)

This slide is hyperlinked to another that lists weapons systems for each category. The following slides visually depict how GI&S supports the warfighter.

This slide and the following three show more specific examples of how GI&S directly affects the mission and the warfighter.

## Slide 12




**GI&S Support to the Warfighter**

- ✓ **Aeronautical Information**
  - Charts
  - Flight Safety/Notice to Airmen
  - Escape and evasion
  - Publications
- ✓ **Hydrographic Information**
  - Combat Charts
  - Digital Nautical Chart
  - Surface/Sub-surface navigation charts
  - Nautical Safety/Notice to Mariners
  - Publications
- ✓ **Topographic Information**
  - Topographic Line Maps/Raster/Vector
  - City Graphics
  - Terrain Analysis
  - Controlled Image Base


The slide includes three circular logos at the top: the Department of Defense seal on the left, the title in the center, and the Joint Staff seal on the right. To the right of the text list are three images: a satellite map, a cockpit view with multiple displays, and a topographic map with a city graphic overlay.

Support to the Warfighter slides focus on various areas that digital GI aid in mission planning and execution. This slide shows examples of “products” available that audience should recognize. Addresses the 3 basic categories: Aeronautical, Hydrographic and Topographic.

## Slide 13




### GI&S Support to the Warfighter





✓ Targeting Information

- Digital Point Position Data Base
- Precision Point Coordinates/Aim Points
- Terrain Contour Matching (TERCOM)
- Gravity

Aim Point Graphic





Targeting is a critical example of GI&S support to the warfighter.

DPPDB is an intelligence product as well as one used for precision in locating target coordinates. It is a stereo image used on high end workstations.

Precise Point Coordinates can be depicted on Aim Point Graphics in the form of kneeboards for pilots

TERCOM for Tomahawk

Gravity for subs to use to aid missile trajectory and pilots to use for Safety of Navigation



The slide is titled "GI&S Support to the Warfighter" and features a collage of images including a satellite, a radar map, a cockpit view, and personnel working at a console. A red-bordered box contains a bulleted list of key areas.

### GI&S Support to the Warfighter


- ✓ Training – Simulators
  - Digital Elevation Data
  - Digital Feature Data
  - Digital fly-throughs
- ✓ Mission Planning
  - Aeronautical Information
  - Hydro/Topo Information
  - Safety of Navigation Information
  - Precise Time & Astrometry

Training and Model & Simulation are also critical tools for understanding how GI&S can effectively be used/demonstrated. Training cannot be overstated! Mission Planning will be the most common use for GI&S throughout the fleet. GCCS-M will have Geospatial Information as the common foundation for the COP/CROP


Common Operational Picture: common throughout the fleet

Common Relevant Operational Picture: common for your location/AOR or your operation

Added Precise Time and Astrometry as these are essential mission planning tools for location and also targeting. Many systems access GPS or position themselves relative to stars and/or earth. USNO is key provider/manager of precise time and astrometry information.



## Datums...Why They Are Important



- ✓ World Geodetic Standard 1984 provides a common accurate reference based on lat/long and accurate estimations of the center of the earth  
[horizontal datum](#)
- ✓ Over 200 local datums are used around the world

| Location        | Datum           | Shift (fm WGS84) |
|-----------------|-----------------|------------------|
| 18Q VT 81170149 | NAD27 (US)      | 201 meters       |
| 52S BS 84457638 | Tokyo (Japan)   | 754 meters       |
| 29° 18' 12.7"N  |                 |                  |
| 47° 46' 57.9"E  | ED-50 (Europe)  | 176 meters       |
| 01° 18' 18.4"S  |                 |                  |
| 15° 46' 56.6"E  | ARC-50 (Africa) | 296 meters       |

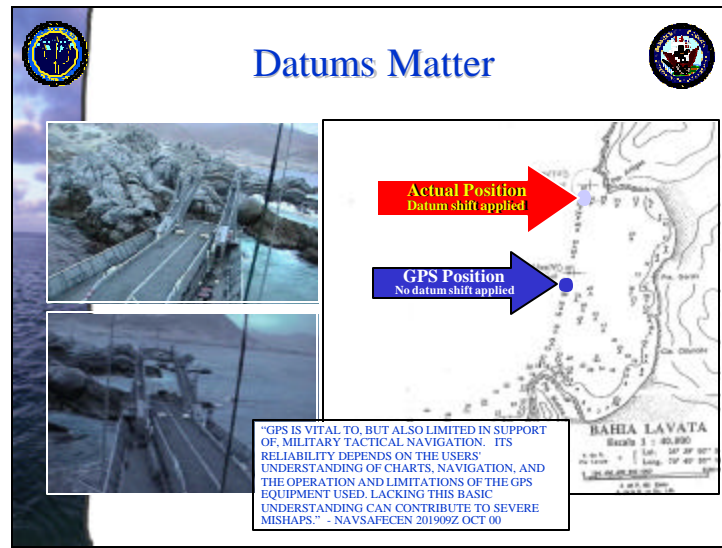
[FLW Example](#)

**Hyperlink to horizontal datum** will show a cartoon of a horizontal datum ellipsoid and explain that it represents a close approximation of the earth. In addition, it will show the “potato” view of the earth from ERS-1 showing earth without water or clouds – point is that in order to have a worldwide horizontal datum (WGS84) you need an accurate approximation of the center of the earth. Any customer can ask NIMA to transform a foreign datum and produce a DNC (they are able to convert over 200 local datums). This eliminates any doubt for using the digital product.

The table shows what the shift in meters would be if WGS84 were applied to another datum (to highlight errors that would be possible if the wrong datum were used with a WGS84 system).

**FLW hyperlink** is the Fort Leonard Wood depiction of the same intersection on two different datums: NAD27 and WGS84.


## Slide 16



The key is now visible on the chart to further emphasize that the datum was not WGS84. Positions indicate what the ship estimated using GPS without shifting to WGS84 and where they really were when the WGS84 datum shift was applied.

In reality, the ship had a chart with no indication of what datum it was based upon and used it in a WGS84 environment (GPS positioning). Without applying the shift to WGS84, they thought they were in good water.





GPS

## GPS Limitations

- ✓ Accurate fix requires minimum of 4 satellites
- ✓ Poor to no signal penetration in dense canopies and water
- ✓ GPS fix plotted on a map is only as accurate as the chart
  - If GPS is +/- 21m and chart is +/- 50m, accuracy is +/- 50m
- ✓ Signal (mil & commercial) susceptible to interference & jamming
- ✓ Military dual frequency signal deters interference
- ✓ Improved GPS system timing will improve position accuracy

Nominal fix also requires an even spread of the 4 satellites,  $>15^\circ$  from horizon and  $< XX^\circ$  from nadir.

Although both military and commercial signals are now available, don't be fooled into using the commercial one with your COTS situational awareness system...it is more susceptible to interference! In addition, once establishing a P-Code lock, you can usually hold it even in a jamming environment.

**P-code**: Precision Code used by the military; provides a dual frequency capability to help prevent interference and jamming. Available on L2 carrier.

**CA-code**: Course Acquisition code used by commercial systems although P and CA are available on the L1 carrier.

Use of COTS systems may increase interference and degrade GPS signals if using CA-code. Some ship groundings have been attributed to this!

**Figure of Merit**: GPS receiver calculates a FOM as an indicator of expected positioning accuracy. It is a confidence-level indicator dependent on the quality of your fix (number of satellites, spread of the satellites, angle off horizon, signal quality, etc.). It does not equate to a numerical value of meters of error, just a good idea of whether you have a good fix or a bad one.

## Slide 18

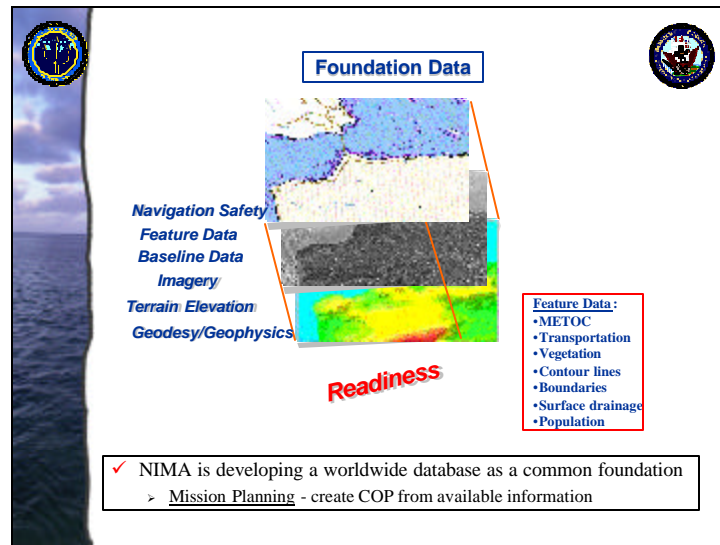


Tactical Tomahawk  
JSF X-35 Joint Strike Fighter  
USS Virginia Class  
CVNX – next generation carrier  
DD21 – USS Zumwalt

Integrated COP/SIAP refers to the interoperability piece and being able to share information to maintain COP

Total Force Interoperability throughout Joint Forces - correlated with JV2020

## Slide 19

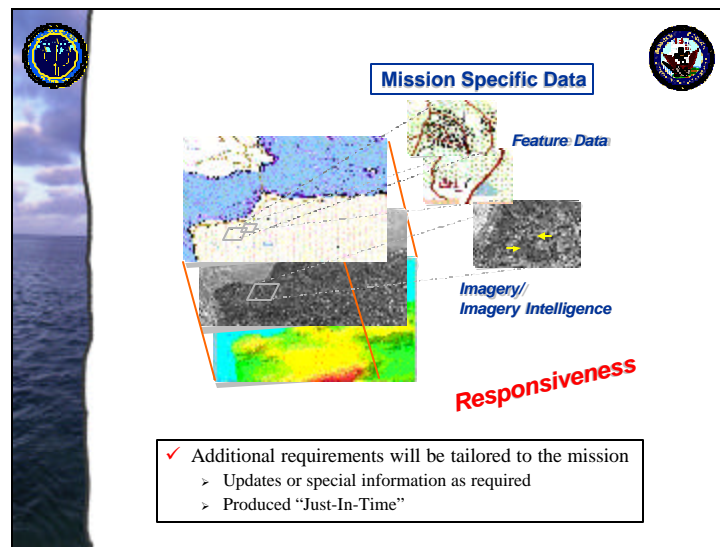


This is a depiction of foundation data. Foundation Data is made up of: DTED2, CIB-5 meter, Hydrographic Information, Aeronautical Information Foundation Feature Data (FFD) which contains thematic layers of data: METOC, transportation, vegetation, contour lines, boundaries, surface drainage, and population

Readiness addresses those requirements which we can request NIMA produce for mission planning and training

**This is the information we should have on the shelf to use for mission planning**

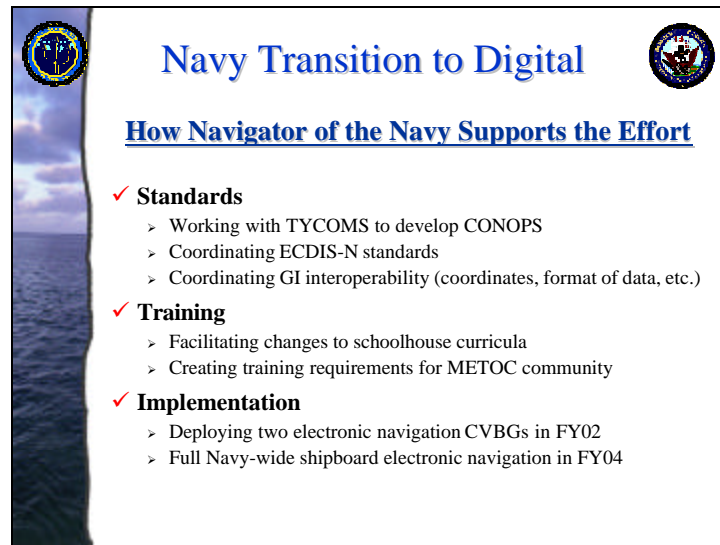
## Slide 20



Mission Specific Data Sets (MSDS) are a densification of data/information tailored to your mission needs

Responsiveness requirements address needs in time of crisis/just-in-time

**Note:** There can be MSDS requirements that fall under readiness. These would, for example be in hot spots where the possibility of crisis is always present.



The slide features a vertical image of a sunset over the ocean on the left side. At the top left and right corners are circular emblems. The main title is 'Navy Transition to Digital' in blue. Below it is a subtitle 'How Navigator of the Navy Supports the Effort' in blue and underlined. The content is organized into three sections, each with a red checkmark icon: 'Standards', 'Training', and 'Implementation'. Each section contains a list of bullet points.

## Navy Transition to Digital

### How Navigator of the Navy Supports the Effort

- ✓ **Standards**
  - Working with TYCOMS to develop CONOPS
  - Coordinating ECDIS-N standards
  - Coordinating GI interoperability (coordinates, format of data, etc.)
- ✓ **Training**
  - Facilitating changes to schoolhouse curricula
  - Creating training requirements for METOC community
- ✓ **Implementation**
  - Deploying two electronic navigation CVBGs in FY02
  - Full Navy-wide shipboard electronic navigation in FY04

### Training

Schoolhouse curricula and DMS courses include:

electronic navigation

hands-on use of GIS systems

understanding GI data



Mobile Training Team Support

METOC Community

Changing personnel training codes to mandate DMS Courses for CINC GI&S

Billets

Facilitating additions to JMTAC, DMS, Boat School, and Post Graduate School courses



**Fleet Implementation of Electronic Navigation**

**Navigation Sensor System Interface  
(NAVSSI)**

A Fully Integrated Weapons System Program of Record

- ✓ Collects, processes, integrates and distributes navigation data to weapon systems, combat support systems and other information system users
- ✓ Provides electronic navigation, charting and voyage management – meets Navy ECDIS-N requirement
- ✓ Installation scheduled for major surface combatants
- ✓ Plan required to address electronic navigation for rest of the fleet

Notes on NAVSSI from NAVSSG Brief:

Make It Reasonably “Off the Shelf”; Leverage/Repackage Existing Designs



Get It to the Fleet fast, inexpensive and on a Path to ECDIS-N

Roughly 90 Ships by FY 04.

\$6.3M in currently available resources

Readily Upgraded to ECDIS-N With Software and Add-ons ---No Ripouts

Acceleration (~240 ship by FY04) is possible but requires an additional \$15.75M in OPN and and \$5.4M in RDT&E in the POM cycle



## Electronic Navigation for the Navy

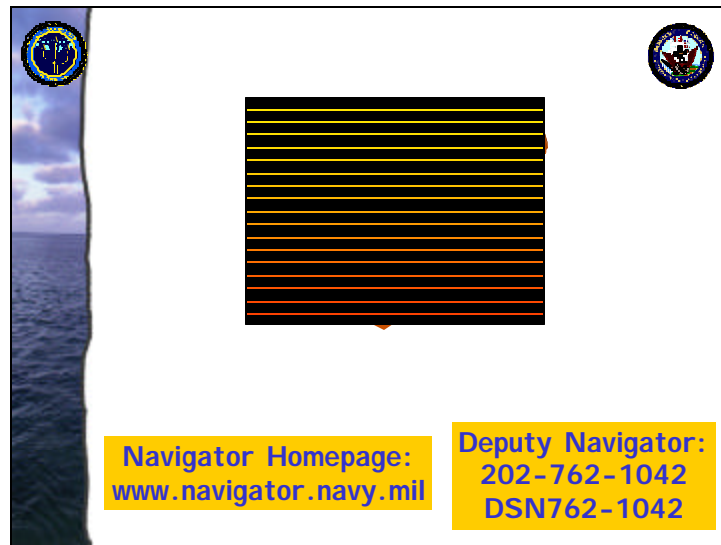
### The Plan

- ✓ Accelerate ECDIS-N certified systems by FY04 - **N6**
  - Field NAVSSI-Lite on Non-NAVSSI platforms\*
- ✓ Deploy two digital electronic navigation CVBGs in FY02

### \*NAVSSI Lite

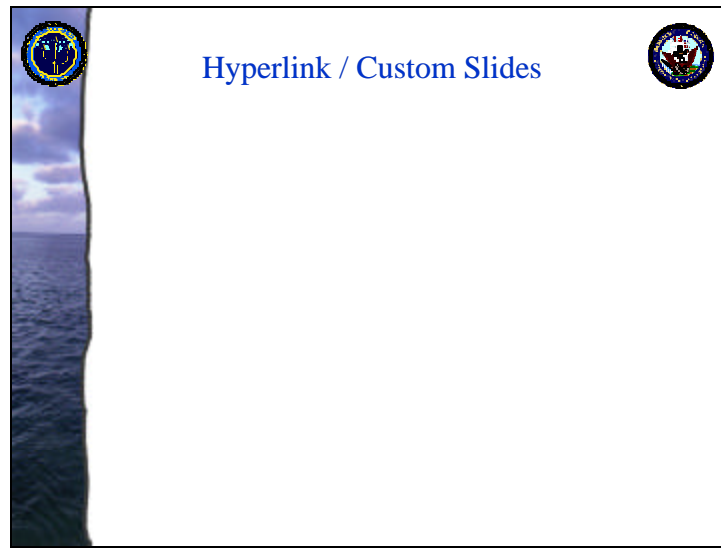
- ✓ Low cost variant of NAVSSI that:
  - Provides relatively low-cost C4I compliant navigation system to ships that do not require/won't receive full-up NAVSSI
  - Satisfies need for achieving 100% Navy Electronic Charting fleet capability ASAP

## Slide 24



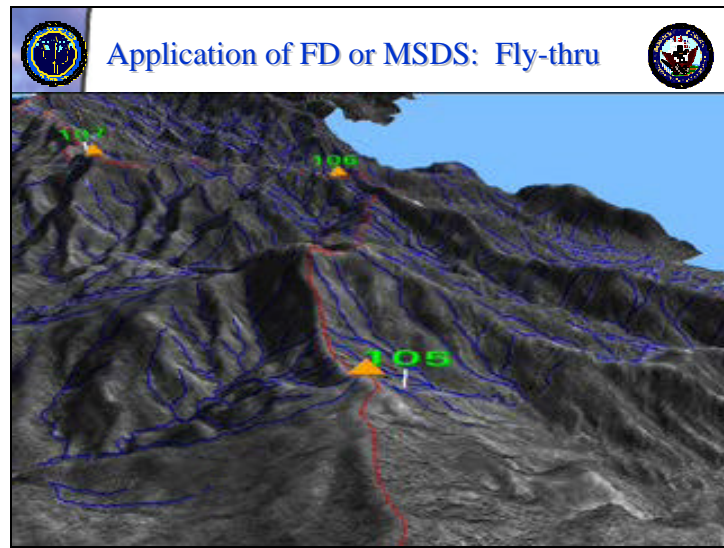


## Slide 25

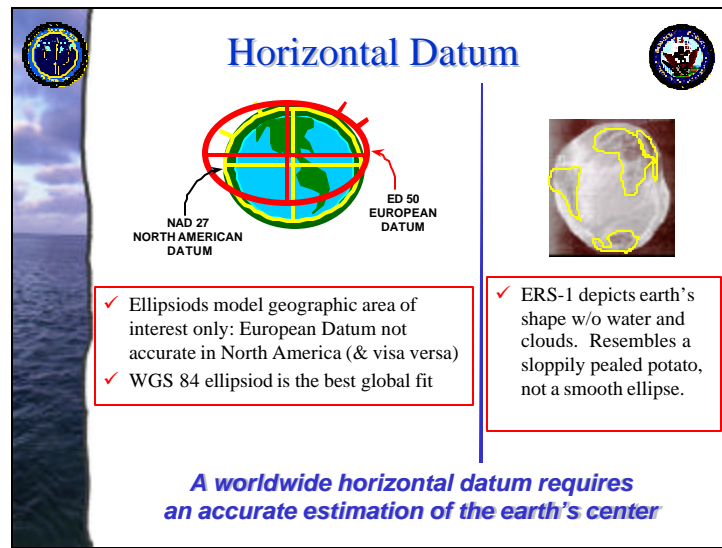


Hyperlink slides tie to the brief. In addition, there will be additional slides developed to address specific audiences to enable a more tailored brief...ongoing effort!

Slide 26



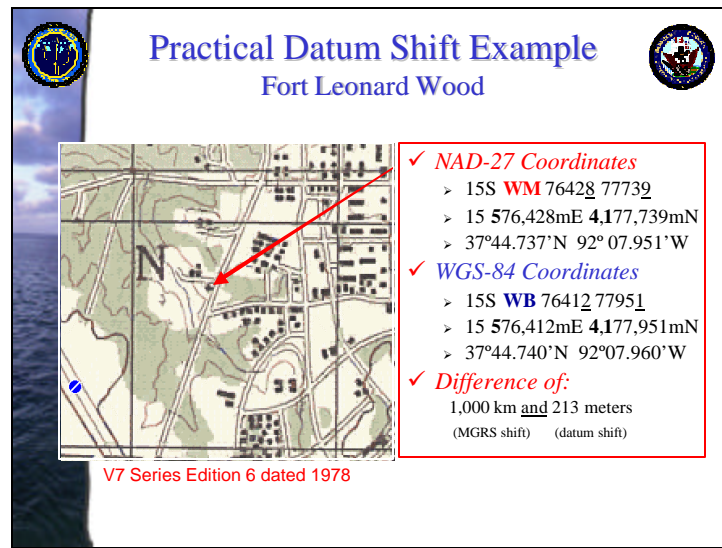
This is a fly-through of Peru that shows CIB (imagery) draped over DTED.



Practically every country in the world has created their own system at some time in the last few hundred years. All of these individual systems produce completely incompatible coordinates. In this example (highly exaggerated for visual effect), the Europeans, who use the European Datum of 1950 (ED 50) (Potsdam), have created a system which models their area of the world, but does not agree with the model that fits North America. The European ellipsoid is bigger and flatter than ours, and their initial point is outside of a university in Potsdam.

As long as all maps and surveys in an area use the same system, there is no problem. But any weapon with a global range will now have a tough time figuring out which system to use in which area. Notice that we don't agree on the location of the center of the Earth.

WGS 84 is the best global ellipsoid fit. This is the accepted common reference standard used worldwide now.



This example looks at the same intersection on a NAD27 and WGS84map, comparing the difference in locations picked off of the maps in various coordinates.

Coordinates are:

Military Grid Reference System (MGRS)

Universal Transverse Mercator (UTM)


Latitude/Longitude

**The difference of 1000km is due to the following:**


The old MGRS system was based on older ellipsoids developed prior to the advent of WGS72 and WGS84. The new MGRS grid for WGS84 is based upon newer ellipsoid models plus a huge shift so as not to confuse users. The 1000km shift depicts the difference between using the old and new MGRS system. Shifting the second letter of the 100,000 meter grid zone designator by 10 letters equates to 1000km (WM to WB equates to 1000km).

**The 213 meter difference** equates to the difference in shifting from NAD27 to WGS84. There is typically a 210 meter shift in the north-south direction when comparing NAD27 and WGS84

## Slide 29



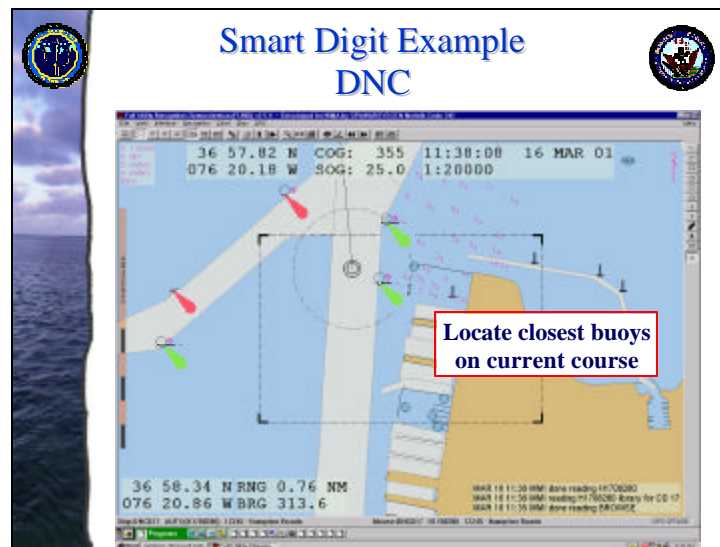
### Digital GI&S



✓ Ties Weapons Systems to Situational Awareness

|   |  |   |
|---|--|---|
| PRECISE<br>WEAPONS<br>SYSTEMS                 | Joint Direct Attack Munitions<br>Joint Standoff Weapon<br>Tomahawk Land Attack Missile<br>Joint Air-to-Surface Standoff Missile  | (JDAM)<br>(JSOW)<br>(TLAM)<br>(JASSM)               |
| ADVANCED<br>NAVIGATION<br>SYSTEMS             | B-2, F-15E, F-16, F/A-18, F-22, V-22,<br>Joint Strike Fighter, Commanche, NAVSSI   |   |
| MISSION<br>PLANNING &<br>REHEARSAL<br>SYSTEMS | Air Force Mission Support System<br>Tact Aircraft Mission Planning System<br>Theater Mission Planning System<br>Special Ops Planning & Rehearsal Sys<br>Digital Topographic Support System | (AFMSS)<br>(TAMPS)<br>(TMPS)<br>(SOFPARS)<br>(DTSS) |
| INTEL / COMMAND<br>AND CONTROL                | Joint Surveil & Target Attack Radar Sys<br>Joint Ops Ping & Execution System<br>Army Battle Command System<br>Combat Intelligence System   | (JSTARS)<br>(JOPES)<br>(ABCS)<br>(CIS)              |

## Slide 30

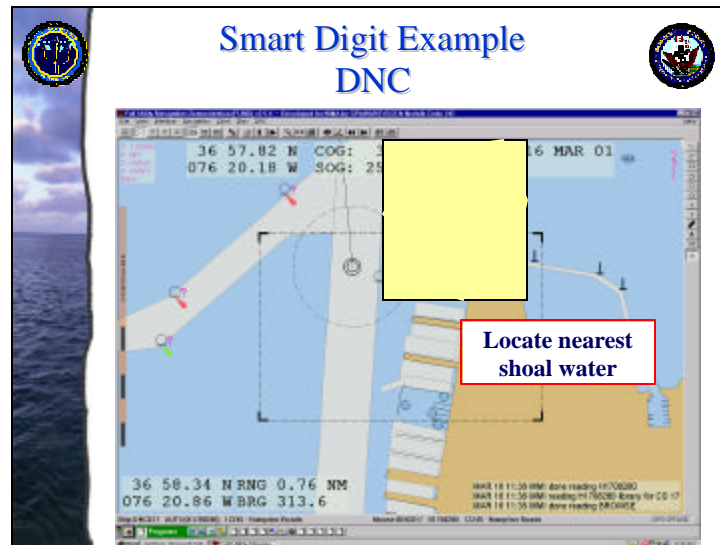


This and the next slide came from a FUND scene of DNC. This illustrates how you can use/manipulate vector data. Buoys can blink as you approach, shoal water areas can blink in warning as you reach an identified distance from them, etc.

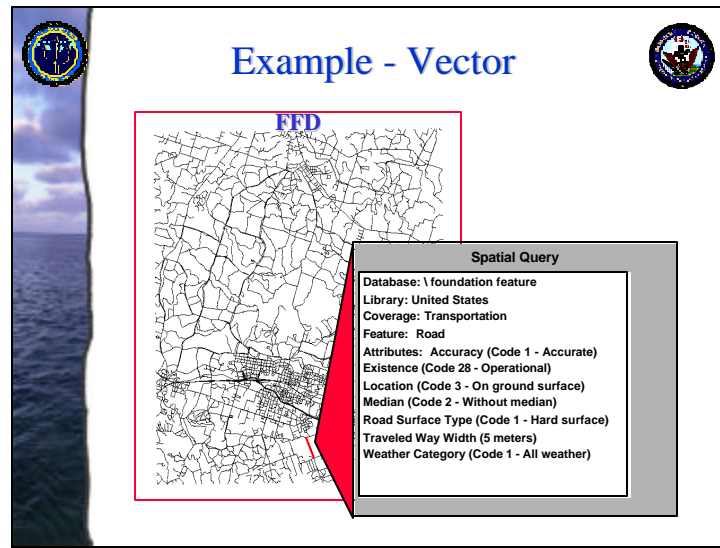
Users can automatically receive warnings of danger zones/areas of interest as you approach them using electronic navigation systems.

Hyperlink currently set to blink 9 times, then stops; you must forward to the next slide to get to the shoal water example.

## Slide 31



## Slide 32



This is a great FFD example as it shows how effectively you can use attribute information for mission planning. This shows not only the existence of the road, but the quality of the data, type of road surface (weight-bearing ability), measurement of the road, etc. A single click provides all of this information!